

AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) A dispenser comprising:

a port member having an inlet port for drawing liquid, an outlet port for discharging the liquid, and a sliding surface in which openings is made, said openings communicating with the inlet port and outlet port, respectively;

a valve member having a sliding surface which is to contact the sliding surface of the port member, arranged to rotate with the sliding surface contacting the sliding surface of the port member, and having three plunger holes which extend parallel to an axis of the dispenser and which are arranged equidistantly around the axis of the dispenser;

drive portion for rotating the valve member;

an end cam having a cam surface of a predetermined profile; and

three plungers inserted in the three plunger holes of the valve member, respectively, to move parallel to the axis of the dispenser;

wherein each of said plungers has a semispherical recess made in one end that opposes the cam surface, a ball is fitted in the semispherical recess to contact the cam surface, a coefficient of friction between the ball and the semispherical recess is smaller than a coefficient of friction between the ball and the cam surface, and the ball rolls on the cam surface when the valve member is rotated, causing the plunger to move

parallel to the axis of the dispenser in accordance with the profile of the cam surface,
wherein:

arcuate grooves to communicate with said openings, respectively, are made in the sliding surface of the port member;

the arcuate grooves have such lengths and assume such positions that three states sequentially and repeatedly occur as the valve member rotates, the first state being that two of the three plunger holes communicate with the arcuate grooves, respectively, and the remaining one plunger hole is closed off from the both arcuate grooves, the second state being that two of the three plunger holes communicate with the arcuate groove communicating with the inlet port and the remaining one plunger hole communicates with the arcuate groove communicating with the outlet port, and the third state being that one of the three plunger holes communicates with the arcuate groove communicating with the inlet port and the remaining two plunger holes communicate with the arcuate groove communicating with the outlet port; and

the cam surface is designed to move the plungers in the following four alternative manners (a) to (d):

(a) when only one plunger hole communicates with the arcuate groove communicating with the inlet port, the plunger inserted in the plunger hole is moved away from the inlet port for a distance proportional to a rotation angle of the valve member;

(b) when only one plunger hole communicates with the arcuate groove communicating with the outlet port, the plunger inserted in the plunger hole is moved

toward the outlet port for a distance proportional to the rotation angle of the valve member;

(c) when two plunger holes communicate with the arcuate groove communicating with the inlet port, the plungers inserted in the plunger holes are moved away from the inlet port for distances the sum of which is equal to the distance for which only one plunger is moved when the plunger hole holding this plunger communicates with the arcuate groove communicating with the inlet port; and

(d) when two plunger holes communicate with the arcuate hole communicating with the outlet port, the plungers inserted in the plunger holes are moved toward to outlet port for distances the sum of which is equal to the distance for which only one plunger is moved when the plunger hole holding this plunger communicates with the arcuate groove communicating with the outlet port.

2. (canceled)

3. (currently amended) A dispenser comprising:

a port member having an inlet port for drawing liquid, an outlet port for discharging the liquid, and a sliding surface in which openings is made, said openings communicating with the inlet port and outlet port, respectively;

a valve member having a sliding surface which is to contact the sliding surface of the port member, arranged to rotate with the sliding surface contacting the sliding surface of the port member, and having three plunger holes which extend parallel to an

axis of the dispenser and which are arranged equidistantly around the axis of the dispenser;

drive portion for rotating the valve member;

an end cam having a cam surface of a predetermined profile; and

three plungers inserted in the three plunger holes of the valve member, respectively, to move parallel to the axis of the dispenser;

wherein each of said plungers has a semispherical recess made in one end that opposes the cam surface, a ball is fitted in the semispherical recess to contact the cam surface, a coefficient of friction between the ball and the semispherical recess is smaller than a coefficient of friction between the ball and the cam surface, and the ball rolls on the cam surface when the valve member is rotated, causing the plunger to move parallel to the axis of the dispenser in accordance with the profile of the cam surface,

~~The dispenser according to claim 1,~~ wherein:

said port member comprises:

a casing having an inlet port for drawing liquid and an outlet port for discharging the liquid; and

a seal disk provided in the casing, having communication holes to communicate with the inlet port and the outlet port, respectively, and having a sliding surface in which the communication holes opens;

said valve member comprises:

a valve disk having a sliding surface to contact the sliding surface of the seal

disk, so arranged in the casing to rotate while abutting on the sliding surface of the seal disk, and having three plunger holes which extend parallel to an axis of the dispenser and which are arranged equidistantly around the axis of the dispenser;

a plunger guide block enabled to rotate together with the valve disk and having three plunger holes which are coaxial with the three plunger holes of the valve disk, respectively; and

a cam-follower guide block so arranged in the casing to rotate together with the valve disk and the plunger guide block and having three guide holes which extend parallel to an axis of the dispenser and which are arranged equidistantly around the axis of the dispenser; and

said plunger member comprises:

three plungers inserted in the three plunger holes of the valve disk and the three plunger holes of the plunger guide block, enabled to slide in the axial direction of the dispenser; and

three cam followers inserted in the three guide holes of the cam-follower guide block, respectively, enabled to slide in the axial direction of the dispenser,

each of said cam followers has a cam-follower body arranged to contact, at one end, the associated plunger and having a semispherical recess in the other end, and one ball set in the semispherical recess to contact the cam surface,

a coefficient of friction between the recess and each ball is smaller than a coefficient of friction between the cam surface and the ball, and

when the cam-follower guide block, plunger guide block and valve disk are rotated, the balls roll on the cam surface and the cam followers move back and forth in

the axial direction of the dispenser, and the plungers are moved back and forth as the cam followers move back and forth.

4. (Original) The dispenser according to claim 1, further comprising first bias portion for biasing the plunger member toward the cam surface, causing the balls to abut on the cam surface.

5. (Original) The dispenser according to claim 3, further comprises first bias portion for biasing the plungers toward the cam surface, causing the plungers to abut on the cam followers and the balls to abut cam surface.

6. (Original) The dispenser according to claim 1, further comprising second bias portion for biasing the valve member toward the port member, thereby to press the valve member onto the port member such that the sliding surfaces of the valve member and port member firmly contact each other.

7. (Original) The dispenser according to claim 3, wherein said cam-follower guide block is shaped like a column having a small-diameter portion, a large-diameter portion, a stepped portion at the junction between the small- and large-diameter portions, a through hole made in the small- and large-diameter portions, holding a shaft of the drive portion and surrounded by the guide holes, and the cam surface of said end cam lies around the small-diameter portion of the cam-follower guide block.